Annual Reporting Form for SCEDDBO Projects and Cores

Administrative Core

Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Marie Lynn Miranda, Richard Auten, Sherman James, Pamela Maxson
Project Period: Year 1

Objectives of Core
The Southern Center on Environmentally-Driven Disparities in Birth Outcomes (SCEDDBO) is governed through an Administrative Core that includes an Executive Committee composed of the Director, the two Co-Directors, and the Project Manager; an Internal Steering Committee composed of members of the Executive Committee and the Directors of the Research Projects and the Facility and Community Outreach Cores, as well as a community member and the Director of the Durham County Health Department; and an External Advisory Committee composed of senior environmental health scientists, as well as community representatives, with expertise relevant to SCEDDBO, who provide informal consultation, as well as annual formal evaluation of Center research and outreach activities.

The specific aims of the Administrative Core are to:
a. Provide scientific direction and leadership;
b. Coordinate and foster interactions among research project and facility core investigators;
c. Provide administrative services for the Center;
d. Direct the Young Investigators program; and
e. Represent Duke's SCEDDBO to the university, the community, the NIH, other Children's Environmental Health Centers across the United States, and the policy and scientific community interested in children's environmental health more broadly.

In all activities, SCEDDBO emphasizes the importance of diversity. The decision to focus on health disparities, the gender and racial diversity of Center leadership, the incorporation of natural, social and biomedical scientists, a commitment to community-based participatory research, and efforts to promote the careers of promising new investigators are all indicative of the importance that we place on fostering environments where all people can prosper.

Progress Report/Summary of Accomplishments
Announcement. The Administrative Core (AC) served as the host for Administrator Johnson when he traveled to Durham to announce the SCEDDBO award. AC personnel worked with Nicholas School and Duke University Offices of Communication and Government Relations to ensure that all substantive and organizational requests from the Administrator's office were fulfilled. A research roundtable allowed SCEDDBO investigators to brief the Administrator on scientific goals and objectives, as well as potential policy applications. The Administrator in turn provided helpful comments on the direction of the center. In addition, a formal event was held on campus, where Administrator Johnson, Stanley Meiburg (EPA), Richard Brodhead (President, Duke University), and Marie Lynn Miranda (PI, SCEDDBO) all offered remarks, followed by Q&A from the audience.

Quality Management Plan. The Administrative Core drafted an initial version of the Quality Management Plan (QMP) that was then distributed to all investigators and staff for critique and comment. Based on this input, the QMP was revised and submitted to the USEPA for approval.

Once final approval was received, copies of the QMP were distributed to all persons working on any of the SCEDDBO projects. These individuals then signed the cover sheet thereby agreeing to abide by the policies laid out in the QMP. The Administrative Core keeps a copy of these signed forms in its files.

Leadership Changes. The SCEDDBO research group suffered a tremendous loss when our center co-director, Marcy Speer, died of cancer in August 2007. Richard Auten agreed to take on the role of center co-director. In addition, Jonathan Goodall moved from Duke to the University of South Carolina (USC). We requested that SCEDDBO be allowed to establish a sub-contract with USC, so that Goodall's work on water quality layers could continue uninterrupted. We also requested that Martha Keating be appointed director of the Community Outreach and Translation Core. All three of these requested changes were approved by the EPA.

Young Investigators Program. In the original plans for SCEDDBO, Marcy Speer was to have mentored both of our Young Investigators. Under our new organizational structure, Rick Auten is mentoring Geeta Swamy, and Sherman James (SCEDDBO's other center co-director) is mentoring Christina Gibson-Davis.

Year one expenditures. Year one expenditures matched projections in most areas. Spending on travel was higher than anticipated, largely due to rapidly escalating fuel and other travel costs. Salary spending was lower than anticipated due to the unexpected loss of our center co-director, Marcy Speer. Personnel decisions to re-delegate her effort and responsibilities were postponed for a time and those salary dollars went unspent. In addition, other technical and laboratory positions that we would otherwise have filled immediately were delayed as we considered how we wanted to reorganize the center.

IRB Certification. A centralized database on IRB and IUCUAC certification and continuing education requirements is maintained through the AC. Twice a year, Dr. Pamela Maxson, the QA Manager, verifies that all researchers associated with SCEDDBO have completed their basic certification and continuing education (one credit of continuing education is required each year to maintain certification) requirements. Reminders are sent to investigators when they are due for additional training. In addition, Dr. Maxson is responsible for ensuring IRB and IUCAUC Protocols are renewed and updated as necessary. All of these documents are posted to the SCEDDBO internal website, and paper copies are centrally maintained by Dr. Maxson.

IRB Audit. Project B: Healthy Pregnancy, Healthy Baby: Studying Racial Disparities in Birth Outcomes was randomly selected by the Duke School of Medicine Compliance Office, Clinical Trials Quality Assurance Group for internal audit. This process took place from December 2007 through January 2008. The final report was received on January 30, 2008. The AC coordinated the interaction with the auditors. The overall assessment was extremely positive, and Project B staff received additional relevant feedback during the audit process.

Meetings. The Executive Committee meets monthly. We typically schedule these meetings in advance of the Internal Steering Committee meetings in order to set the agenda for the larger group meetings. In addition, in January 2008, the Administrative Core hosted the first meeting of the Science Advisory Committee (SAC). We provided the SAC with documents outlining the basic goals and objective of each center component – as well as overall SCEDDBO goals. Staff associated with each center component also developed a list of questions on which they especially sought the advice and guidance of the SAC. These questions guided much of our discussion and led to a very productive meeting.

Website. The AC provided material on SCEDDBO to the EPA for uploading to the EPA children's centers website. In addition, we established a site describing SCEDDBO. This site is linked off the website for the Children's Environmental Health Initiative (www.nicholas.duke.edu/cehi). We also established a secure internal website that allows for discussion boards, email communication, and document storage associated with the work of each of the SCEDDBO components.

Conferences. SCEDDBO PI Miranda and Project Manager Maxson, attended the October 2007 children's center conference in Washington, D.C., hosted by the EPA. Marie Lynn Miranda presented work on the GIS portal that was developed in support of environmental health needs in the aftermath of Hurricanes Katrina and Rita. Miranda also provided a keynote address on the use of spatial analysis in environmental health research at the EPA-sponsored Sustainability Conference held in Chapel Hill, NC. In addition, in October 2007, Miranda gave the opening plenary address to the International Society for Exposure Assessment. Her talk was entitled "Fostering Environments where All Children Can Prosper."

Supplement. The AC coordinated the submission of a supplement request to the EPA. If funded, this proposal would allow us to link SHEDS modeling approaches with birth record data that is being used in Research Project A.

Identification of training opportunities. The AC works with all of the other SCEDDBO components to identify key training opportunities for investigators and other research staff. Through this effort, we have developed greater expertise in remotely sensed data, air pollution modeling, centering models of patient care, spatial statistics, and information science.

Project A: Mapping Disparities in Birth Outcomes

Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Marie Lynn Miranda (PI), Alan Gelfand, Sherman James, Pamela Maxson, Geeta Swamy
Project Period: Year 1

Objectives of Research
Project A utilizes the conceptual framework of the "weathering hypothesis," which posits that chronic and persistent stressors lead to accelerated biological aging of women, which in turn accounts for adverse birth outcomes among certain subpopulations. The central objective is to determine whether and to what extent joint exposures to socioeconomic and environmental stressors contribute to racial and ethnic health disparities in fetal growth restriction.

Using a geographically-based nested study design moving from analysis of births for the entire State of North Carolina to six demographically and geographically distinct counties to a single health center and state-of-the-art Geographic Information Systems applications with Bayesian spatial hierarchical modeling and other advanced spatial statistical approaches, the specific aims are to:

1. Spatially link detailed birth record, fetal death certificates, socioeconomic, environmental, tax assessor, community-based, and clinical obstetric data at highly resolved scales for the State of North Carolina from 1990-2003;

2. Refine the concept of fetal growth restriction by a) developing a joint distribution for birthweight and gestation using bivariate modeling for live births and fetal deaths – both separately and jointly, and b) defining it in terms of fetal and infant mortality, rather than percentile cut points; and

3. Determine whether and to what extent differential exposures to both environmental and social stressors help explain health disparities in fetal growth restriction among a) African-American women compared to Non-Hispanic white and Hispanic women, b) Older African-American women compared to younger African-American women, c) Hispanic women compared to Non-Hispanic white and African-American women, and d) Foreign born Hispanic women compared to US born Hispanic women.

This project evaluates a large number of factors in diverse populations, providing broad relevance for birth outcomes across time, space, and demography. Identifying social and environmental factors contributing to fetal growth restriction will improve our understanding of disease etiology and explain the racial disparity in disease incidence, leading to effective interventions against poor outcomes in all population groups.

Progress Report/Summary of Accomplishments
Over the past year, the Project A research team has met weekly to discuss new research ideas, review progress of current analysis and identify next steps, and work on manuscript preparation.

We have done considerable methodological work on how to *synthesize categorical datasets* to enhance inference. We are particularly interested in how to deal with a collection of datasets of varying sizes that are all relevant to a particular scientific question, but which include different subsets of the relevant variables, with some overlap. This work attempts to synthesize cross classified categorical datasets drawn from a common population where many of the sets are incomplete (i.e., one or more of the classification variables is unobserved), but at least one is completely observed. This is expected to reduce uncertainty about the cell probabilities in the associated multi-way contingency table as well as for derived quantities such as relative risks and odds ratios. We have made substantial progress on the underlying modeling and have developed a simulation example as well. A manuscript on this work is presently in submission.

Out of efforts to develop new spatial methodologies for addressing health disparities, additional methodological work on *disaggregated spatial modeling for areal unit categorical data* is currently underway. This work uses innovative statistical methodology that extends spatial disease mapping techniques to model subgroups within areal units using a spatially smoothed, multilevel loglinear model. A presentation based on this work was given at the annual meeting of the American Public Health Association in November 2007, and a related manuscript is presently in submission. We are also exploring the public health applications of this methodology to elucidate health disparities across space and subgroups.

We have spent considerable time linking the detailed birth record data to USEPA PM_{10}, $PM_{2.5}$, and ozone monitoring data in order to study the impact of *maternal exposure to air pollution* on birth weight. We are especially focused on refining exposure metrics to most effectively characterize meaningful exposures, as well as to capture any windows of vulnerability. Significant progress has been made on the relationship between birth outcomes and exposure to particulate matter and ozone separately, and the current focus is determining how to characterize joint exposure to both particulate matter and ozone.

Our project on *racial residential segregation* is in an earlier stage of development, but promises to reveal key insights into how to think about the spatial aspects of the social factors influencing

health disparities. We are working to determine which facets of segregation best characterize the way community-level racial residential segregation acts to promote health disparities in birth outcomes. Although our initial efforts were statewide, we have since decided that, given the significantly more detailed data available for Durham County, we will focus on this area while we work to determine what variables are most important to characterizing racial residential segregation in terms of its health consequences.

In addition, we have been working on specific analysis and manuscripts examining the impact of maternal age and birth order on birth weight, the joint distribution of birth weight and gestational age, and etiology of racial disparities in maternal hypertensive disorders.

Collaborations with other SCEDDBO Components
We have worked closely with the Project C investigators to design analysis looking at the same pollutants at comparative levels of exposure from different methodological perspectives. Our discussions with the investigators of Project C help inform our methods for framing ozone and particulate matter exposures in our models, as well as help refine the planning and implementation of future animal models in Project C. In addition, we regularly trade insights with Project B regarding appropriate ways to model the joint impact of social and environmental stressors on pregnancy outcomes.

Future Activities
We plan to continue working on each of the areas described in the progress report/summary of accomplishments section. Achieving a better understanding of exposure to air toxins, particularly particulate matter and ozone, is a central focus of our future efforts. Areas of investigation will include interpolation using space-time measurement error models and modeled individual dose exposure using the SHEDS software.

We recently began the process of linking participants in Project B with their associated birth certificate record. We are excited to begin exploring the additional insights into the detailed birth record data that can be gleaned by linking these data with the rich dataset collected in Project B. This linkage will not only allow us to explore issues of data accuracy in the detailed birth record, but will also allow us to begin implementing the methods of synthesizing categorical data discussed above.

We have targeted several professional audiences for dissemination of our work. Plans are underway to present our work at the following conferences: Joint Statistical Meetings, American Public Health Association, Society of Epidemiological Research, International Biometric Society, and the Society of Maternal and Fetal Medicine.

Publications
Tassone, E., Miranda, ML., Gelfand, A. Disaggregated Spatial modeling for Areal Unit Categorical Data. In submission.

Miranda, ML., Bhattacharya, S., Swamy, G., Gelfand, A. Synthesizing Categorical Datasets to Enhance Inference. In submission.

Presentations
Kaiser LM, Miranda ML, Hussey J, Buescher P, Swamy GK, *Association of Adequacy of Prenatal Care Utilization and Maternal Health Status with Birth Outcomes in North Carolina, 1999-2003*, Poster Presentation at Society for Gynecologic Investigation Annual Scientific Meeting, , March 2008, San Deigo, CA.

Miranda, ML, Gelfand, A, Swamy, G, Gray, S, Edwards, S. *Effect of PM10 and PM2.5 Exposure on Birth Weight in North Carolina.* American Public Health Association, November 2007, Washington, D.C.

Gray, S., Miranda, ML, Gelfand, A. *Process Modeling for Ordered Categorical Data.* Joint Statistical Meetings, August 2007, Salt Lake City, UT.

Miranda, ML, Gelfand, A, Gray, S. *Process Modeling for Ordered Categorical Data.* Eastern North American Region, March 2008, Washington, DC.

Swamy GK, Edwards S, Gelfand A, Miranda ML, *Maternal Age, Birth Order, and Race: Differential Effects on Birthweight,* Poster Presentation at UNC Women's Health Research Day Annual Scientific Meeting, April 2008, Chapel Hill, NC.

Tassone, E, Miranda, ML, Gelfand, A. *Disaggregated Spatial modeling for Areal Unit Categorical Data*, Joint Statistical Meetings, August 2007, Salt Lake City, UT.

Supplemental Keywords
Data fusion, meta analysis, disparities, spatial disaggregation, spatial interpolation, spatial modeling

Research Project B: ***Healthy Pregnancy, Healthy Baby: Studying Racial Disparities in Birth Outcomes***

Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Redford Williams (PI), Allison Ashley-Koch, Christina Gibson-Davis, Pamela Maxson, Marie Lynn Miranda, Jerome Reiter, Geeta K. Swamy,
Project Period: Year 1

Objectives of Research
The central objective of the Healthy Pregnancy, Healthy Baby Study is to determine how the interaction of environmental, social, and host factors contributes to disparities in birth outcomes between African-American and white women in the American South. There are four specific aims:
1. Conduct a cohort study of pregnant women in Durham, NC designed to correlate birth weight, gestation, and birth weight x gestation with environmental, social, and host factors;
2. Develop community-level measures of environmental and social factors by inventorying neighborhood quality and the built environment in partnership with local community groups;
3. Create a comprehensive data architecture, spatially resolved at the tax parcel level, of environmental, social, and host factors affecting pregnant women by linking data from the cohort study and neighborhood assessments with additional environmental and socioeconomic data; and
4. Determine whether and to what extent differential exposures explain health disparities in birth outcomes by applying innovative spatial and genetic statistical methods to:

a. Identify environmental, social, and host factors that cluster to predict birth outcomes in the entire sample,
b. Determine whether these clusters are more or less present in African-American versus white populations and quantify the proportion of health disparities explained by differences in cluster frequency, and
c. Identify environmental, social, and host factors that cluster to predict birth outcomes within the African-American and white sub-samples and compare these clusters across racial groups.

Progress Report/Summary of Accomplishments
As of 4/1/08, 933 women have been enrolled in the study, with only 46 women withdrawn or lost to follow-up. Women are recruited from Duke University Medical Center (DUMC) and Lincoln Community Health Center. Demographic data indicate that we are successfully recruiting women who are most at risk for adverse pregnancy outcomes, particularly low-income, low educational attainment, and non-Hispanic black women.

The following information is collected from participants in the Healthy Pregnancy, Healthy Baby Study:
- Psychosocial measures include: CES-D, perceived stress, self-efficacy, interpersonal support, paternal support, perceived racism, perceived community standing, pregnancy intention, John Henryism Active Coping Scale, NEO Five Factor Inventory of personality.
- Environmental exposure survey measures include: short survey on fish consumption, smoking pattern and exposure to second-hand smoke, and drinking water source.
- Maternal and neonatal medical record abstraction includes: detailed pre-pregnancy medical and social history, antepartum complications, birth outcomes, and neonatal complications.
- Blood samples for genetic and environmental analysis to assess candidate genes related to environmental contaminant (nicotine, cotinine, cadmium, lead, mercury, arsenic, and manganese) metabolism, inflammation, vascular dysfunction, and stress response.
- Cord blood and placental samples are currently being stored for future genetic analysis and evaluation of activity at the maternal-fetal interface.

We have been highly successful in collection of participant-level data as well as biological samples, with greater than 90% attainment of maternal blood sample for genetic and environmental analyses. Collection of cord blood and placental samples, which began in June 2007, has also been successful with approximately 150 delivery samples collected.

All maternal data is georeferenced (i.e., linked to the physical address of the mother) using Geographic Information System (GIS) software. The Healthy Pregnancy/Health Baby Study also includes an in-depth neighborhood assessment designed to capture both built environment and community-level social stressors and community resources. The cohort study and neighborhood assessment data are spatially linked to extensive environmental and demographic data at a highly resolved spatial scale.

To date, we have generated genotypes on 624 blood samples from pregnant women for 104 Single Nucleotide Polymorphisms (SNPs) in sixteen genes, primarily involved in either metabolism of heavy metals or immune response.

Collaborations with other SCEDDBO Components
Collaborative efforts with investigators within other components of SCEBBO are ongoing. Plans for protein and candidate gene analyses are being formulated and finalized in conjunction with investigators from Project C such that associations with adverse birth outcomes as well as

gene-environment interactions can be further evaluated or replicated in the mouse-model system and vice versa. Analyses of psychosocial stressors in relation to birth outcomes are being devised in combination with investigators from Project A who have expertise in social epidemiology as well as racial disparities in health outcomes.

Future Activities
In the upcoming year, we will continue to enroll study participants with our target sample size of 1500 pregnant women.

We will begin preliminary analyses on approximately 700 – 800 participants with complete pregnancy data, genetic results, and environmental results. Analyses will look at the joint impact of environmental, social, and host factors on birth outcomes, especially as they differ by race. Identification of such co-exposures could lead to development and implementation of strategies to prevent adverse birth outcomes, ultimately decreasing or eliminating the racial disparity.

Maternal blood samples will be analyzed for both protein and genetic associations with adverse birth outcomes. Maternal samples collected at 24 – 28 weeks gestation will be analyzed for protein levels involving markers of inflammation, vascular dysfunction, and stress response. DNA analysis is well underway with genotyping completed for several genetic polymorphisms regarding environmental contaminant metabolism as well as inflammatory cytokines and chemokines. Genotyping will continue and include genes involved in the maternal stress response and vascular/endothelial cell dysfunction. Statistical analysis regarding candidate gene polymorphisms will begin in June 2008. We will continue to genotype SNPs in the candidate genes we had proposed, as well as genotyping new, pertinent genes as the literature suggests (i.e., GRK2/GRK5 as described by Liggett et al., 2008). In addition, during year 2, we will begin genotyping functional polymorphisms such as the 5HTTLPR in the serotonin transporter.

While our Children's Center is focused on birth outcomes, we realize the importance and valuable opportunity that we have to continue to follow the children born to our study participants. We are investigating the feasibility and funding opportunities to conduct a follow-up study of these children that would include assessment of the child's home environment and neuro-cognitive functioning as well as maternal psychosocial and physical health and how it contributes to childhood well-being. We would then link these measures to the data collected prenatally to determine how such measures affect developmental trajectories for children.

Publications
We are currently in the enrollment and data collection phase of the study but have begun to perform preliminary analyses.

Presentations
Maxson, P., Gibson-Davis, C., Swamy, G., Williams, R., Miranda, ML. *Impact of psychosocial health on pregnancy intention*. APHA, November 2007, Washington, DC.

Maxson, P, Gibson-Davis, C, Williams, R, Swamy, G, Miranda, M. *The relationships between pregnancy intention, social variables, and birth outcomes*. Women's Health Research Day, University of North Carolina, April 2008, Chapel Hill, NC.

Supplemental Keywords
Pregnancy, preterm birth, low birth weight, racial disparity, African American, environmental stressors, gene-environment interactions, psychosocial stressors, genes, single nucleotide polymorphisms

Project C: Perinatal Environmental Exposure Disparity and Neonatal Respiratory Health

Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Richard Auten (PI), W. Michael Foster
Project Period: Year 1

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Objectives of Research: Specific Aims
1. To determine whether maternal exposure to airborne particulates (PM) and/or ozone (1st hit) restricts fetal growth and/or postnatal growth, and impairs lung development/function in newborn mice;

2. To determine whether PM and/or ozone exposure 're-programs' maternal inflammatory responses;

3. To determine whether postnatal (2nd hit) ozone exposure further impairs postnatal somatic and lung development/function following maternal PM and/or ozone exposures;

4. To determine whether genetic or developmental susceptibility to airway hyperreactivity exacerbates maternal and/or postnatal exposure effects on postnatal somatic and lung development/function.

Progress Report/Summary of Accomplishments
1. We have determined that postnatal ozone (1 ppm x 3h/d, 3 d/week x 4 weeks) significantly impairs postnatal weight gain in C56BL/6 mice. *Air pollutant exposure at a vulnerable window of postnatal development impairs growth.*
2. Postnatal ozone increases nebulized methacholine induced airway hyperreactivity (AHR) in C57BL/6 mice measured at 4 weeks but not 3 weeks. *Ozone induced AHR is developmentally regulated.*
3. We have found that prenatal instillation of particulate matter (St. Louis particle, NIST#1648) twice weekly in time mated pregnant mice augments postnatal ozone-induced AHR in mice, measured at 4 weeks postnatal. *Prenatal air pollutant exposure reprograms postnatal air pollutant responses that result in AHR.* A manuscript is in preparation to report these findings.
4. In studies just completed in collaboration with M. Ian Gilmour, EPA , we exposed time-mated C56BL/6 pregnant mice to internal combustion engine diesel exhaust (0.5, 1, & 2 mg/m^3 x 6h/d, 5d/week, from gestation day 6-17) v. air control. Pups delivered to exposed dams were exposed postnatally to ozone as described above. Prenatal diesel exposure dose-dependently impaired lung compliance and pressure-volume loop hysteresis v. air or prenatal air postnatal ozone controls. There were parallel effects on nebulized methacholine challenge induced AHR. *Prenatal ambient exposures to diesel particulates at doses relevant to human environmental exposure worsened postnatal ozone-induced lung function and AHR.*

Collaborations with other SCEDDBO Components
Results from Project C have been shared with project leaders, and we have accordingly refined the analysis of environmental exposure correlations with health effects markers in Project A. We are also exchanging insights with investigators from Project B on parallel results in the animal and human cohorts.

Future Activities
We have developed a recent collaboration with M. Ian Gilmour, US EPA, Research Triangle Park, NC to enable us to perform prenatal diesel particle exposures at concentrations and doses that more closely resemble human environmental exposures. Since the thrust of our project is to determine *combined* exposure effects on pregnancy and postnatal somatic and lung development, we are working on developing a system to perform simultaneous or alternating diesel and ozone exposures. This novel exposure scheme is now being developed and will being early in Year 2 of the project.

Major mechanistic questions underlie the link between prenatal exposure(s) and adverse neonatal outcomes. Since maternal inflammation is a mechanism central to many exposures implicated in fetal growth restriction, postnatal development, and postnatal morbidities, our plan is to test the concept by performing the single and combined pre- and post-natal exposures using inbred mouse strains with genetically determined but differing inflammatory repertoires in Year 2.

Publications
One publication is nearly ready for submission which will report the initial observations outlined in brief in the summary of accomplishments (1-3).

We expect to submit a second manuscript by October 2008 describing the effects of maternal airborne ambient diesel exhaust particle exposure during mid-pregnancy on post-natal ozone-impaired lung structure and function.

Brown J, Graham JA, Chen LC, Postlethwait EM, Ghio A, Foster WM, GordonT. "Assessing Biological Plausability of Epidemiological Findings in Air Pollution Research." *J Expos Sci Environ Epidem* 17:S97-105, 2007.

Presentations
While several presentations are planned for year 2, we do not have any presentations to report for this reporting period.

Supplemental Keywords
Airway hyperreactitivity, diesel exhaust particles, air pollution, lung function

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Community Outreach and Translation Core

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Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Martha H. Keating (PI); all SCEDDBO investigators are involved in some aspect of the COTC's work
Project Period: Year 1

Objectives of Research

The central objective of the Community Outreach and Translation Core (COTC) is to create, implement, and assess strategies to translate and apply the findings of the Southern Center on Environmentally-Driven Disparities in Birth Outcomes (SCEDDBO) into relevant information for women of childbearing age, families, community groups, policy makers, and health care professionals. The COTC will conduct environmental health outreach and education directed at low income and minority women and their children; enhance the capacity of disadvantaged communities to understand threats posed by environmental contaminants; and provide a bridge between campus research, communities and policy makers. The specific aims of the COTC are:

1. Support the community-based neighborhood assessment being undertaken as part of Research Projects A and B;
2. Partner with nursing programs at Duke-affiliated hospitals to develop and present curricula to nursing students on environmental exposures and maternal and child health outcomes;
3. Develop culturally-appropriate advisory materials on environmental contaminants for low-income expectant or nursing mothers with low English proficiency;
4. Deliver training to local health department personnel focused on environmental factors related to maternal health and pregnancy outcomes;
5. Participate in regional, state and federal policy dialogues to provide decision makers with policy-relevant science-based information concerning environmental exposures and health disparities related to maternal and child health and well-being; and
6. Increase awareness of maternal health and health disparities by facilitating bi-directional exchanges between Center investigators, community members, public health advocacy groups, and policy makers.

Progress Report/Summary of Accomplishments

In Year 1, COTC staff completed the initial data collection for the Neighborhood Assessment project, significantly increased the number and diversity of potential partners and audiences for SCEDDBO research, and completed the research design for two projects that represent Specific Aims for the Core. In addition, the COTC has served as an information resource for numerous private citizens and journalists requesting information on a variety of environmental exposures and effects on children.

The Neighborhood Assessment team piloted a built environment survey launched off handheld GPS units. The pilot focused on 22 neighborhoods (14,500 tax parcels) in Central Durham. The field survey used a GIS-based tool to conduct a consistent, parcel-level survey of built environment characteristics. For each tax parcel, 66 variables are noted. An additional 2,200 parcels outside of the 22 central neighborhoods were identified to improve overlap with the addresses of Project B participants. We anticipate scaling up from pilot to full assessment during summer 2008. The assessment has already proved to be an important outreach tool with use of the pilot data by various community organizations, as well as the City of Durham Neighborhood Improvement Services to identity areas of critical need in the City.

Specific Aim 2 of the COTC is to partner with nursing programs at Duke-affiliated hospitals to develop and present curricula to nursing students on environmental exposures and maternal and child health outcomes. We have designed a comprehensive project to address this aim including developing a partnership with nursing school faculty to carry out the project. This

proposed project consists of three linked activities: 1) integration of environmental health content into the curriculum of an Accelerated Bachelor of Science in Nursing program at Duke University through the community health nursing course; 2) development and provision of online teacher and student resources which will enable nursing faculty at any location to incorporate environmental health concepts into nursing curriculum and nursing practice; and 3) development and accreditation of an online continuing nursing education (CNE) module focused on environmental health. Having completed project design, we are now seeking additional funding to support implementation of the project. An environmental education proposal has been submitted to the USEPA via Region 4.

To address Specific Aim 3, we have developed a working relationship with staff from the NC Nutrition Services Branch (within the Department of Health and Human Services) to improve advisory materials about environmental contaminants in food. Together, we are exploring the development of an outreach model for communicating complicated environmental health information to pregnant or early postpartum Latina women. The intended audience is the nearly 17,000 Latina women who participate in the Supplemental Nutrition Program for Women, Infants, and Children (WIC) in NC. Of all of the Latino babies born in NC in 2005, 53% were born to mothers who participate in the WIC Program. In particular, we are interested in designing and testing culturally/linguistically appropriate messages and message delivery formats for fish consumption advisory information. We are engaging in this work in collaboration with the Outreach Core of Duke's Superfund Center.

COTC staff was invited to join a North Carolina Preconception Health Task Force which is comprised of multiple NC agencies involved with women's health, various departments of the University of North Carolina and non-governmental organizations. The task force will initially address pregnancy intention and female obesity as these conditions relate to children's health. This task force has been an ideal opportunity to raise awareness of environmental influences on birth outcomes and obesity with agencies where environmental factors have really not been considered previously. Particular interests of this group have been the influence of the built environment on obesity and pregnancy outcomes, and using GIS to visualize health data, health outcomes, and intervention strategies.

Collaborations with other SCEDDBO Components
COTC staff meets monthly with the SCEDDBO investigators to keep apprised of research developments and findings, translation opportunities, and scientific outreach activities (e.g., meetings, presentations and manuscripts) of the SCEDDBO investigators. The COTC staff also provides the investigators with updates on COTC activities and opportunities to participate in outreach activities. At the beginning of Year 1, COTC staff interviewed each SCEDDBO investigator to become familiar with each investigator's research interests, important crossover issues (between SCEDDBO projects), major venues for translation activities, relevance of the SCEDDBO project to contemporary issues and policy development.

External Collaborations
The COTC has developed a wide and diverse network of collaborators among federal, state and local agencies, universities and community groups. Activities with these diverse partners cover a broad spectrum of children's environmental health issues, ranging from birth outcomes to lead poisoning prevention, environmental exposures, and obesity.

COTC staff has developed working relationships with scientists at the U.S. EPA representing a wide variety of disciplines. As a result, the COTC is now frequently contacted by EPA in order to

exchange ideas and research findings. These relationships have resulted in periodic meetings with EPA staff specifically related to:

- ozone and PM exposure and its relationship to birth outcomes,
- methods for using the North Carolina detailed birth record for exposure analysis,
- pesticide exposure and outreach to migrant farm workers, and
- environmental justice issues.

Building relationships with North Carolina agencies has been a particular focus for the COTC in Year 1. Activities with these agencies cover a wide variety of topics including the impact of the built environment on obesity and pregnancy outcomes, mapping environmental exposures, mapping built environment variables,   The COTC is actively working with staff at numerous state offices, particularly within the Division of Public Health. These offices include: Senior Advisor for Healthy Schools, Women's Health Branch, Nutrition Services Branch, Education and Community Programs, NC Physical Activity and Nutrition Branch, Occupational and Environmental Epidemiology Branch.

The COTC has also facilitated information exchange between SCEDDBO investigators and the University of North Carolina (specifically the Cecil G. Sheps Center for Health Services Research) regarding neighborhood assessments, the built environment, and using GIS to map health outcomes. In addition, SCEDDBO investigators mentored two students in the "Break the Cycle" project sponsored by Region 4 of the USEPA, Emory University, and the Southeast Pediatric Environmental Health Specialty Unit.

As an extension of the data collection for the Neighborhood Assessment Project, COTC staff have met with community members to discuss dissemination of the results. Using a variety of formats including printed map posters, GIS demonstrations, and oral presentations the project has been described to community groups in Durham in several venues. Some changes were also made in geographic coverage of the assessment to reflect additional neighborhoods in Durham that hold special interest for community groups.

The COTC has also responded with detailed information to numerous requests from private citizens about a variety of environmental health concerns. Topics have ranged from lead and mercury exposure to electromagnetic fields, chloramines, and exposure to rubber crumblets. These requests were received through both the CEHI toll-free number and via the CEHI website.

Future Activities
Activities planned for the COTC in Year 2 will build on the accomplishments of Year 1 and will also expand communication and translation efforts to specific audiences. With a networking infrastructure in place, the COTC will focus on implementing a structure for consistent communication, using various communication tools appropriate to a variety of audiences.

A principal activity for the COTC in Year 2 will be the development and implementation of a comprehensive communication strategy. As part of this effort, a SCEDDBO website will be launched off of the Children's Environmental Health Initiative portal. The strategy will encompass communication activities ranging from peer-reviewed manuscripts to community meetings. The strategy will provide a consistent structure and mechanism for tracking activities, and for preparation and dissemination of appropriate outreach and/or translation materials for different audiences.

The Neighborhood Assessment/Built Environment project will expand in two major ways in Year 2. First, all of the 14,500 tax parcels which were surveyed in Year 1 will be re-assessed. This second data collection effort will enable comparisons to be made over time as well as provide data collected in a single season by a consistent team. Second, a social survey will be undertaken in specific places within the city. A social survey will allow variables like social support and neighborhood activities to be assessed and incorporated into the housing dataset. Data collected at this refined scale will be linked with other parcel-level data such as housing tenure, crime incidence, housing code violations, community resources, and a variety of health outcome data. The neighborhood assessments will be shared with local government and community organizations to better address housing and health needs in the city. In addition, the built environment variables will be incorporated into analyses of the etiology of complex health outcomes.

With appropriate funding, the COTC will carry out the projects designed to address Specific Aims 1 and 2, specifically in the areas of risk communication to vulnerable populations and incorporating environmental health topics into continuing nursing education.

COTC staff will continue to participate in the NC Preconception Health Work Group and contribute fully to defining the state action plan to address pregnancy intention and women's obesity and chronic disease.

The COTC also expects to mentor additional students in the Break the Cycle project with the Southeast Pediatric Environmental Health Specialty Unit.

Collaboration with researchers and groups external to SCEDDBO will continue to evolve and the COTC will continue to welcome and respond to requests for environmental health information to community groups as well as the general public.

Publications
Given the early stages of many of our projects, the COTC does not yet have any draft publications in submission. We plan to identify key opportunities for manuscript preparation in Year 2.

Presentations
Rebecca Yates Coley, Jeffrey Davis, Anthony Collins, Amber Ingram, Kristin Marin, Marie Lynn Miranda. "Developing a Tool for Conducting Assessments of the Built Environment." American Public Health Association, November 2007, Washington, DC.

Martha H. Keating. "Fish Choices: Balancing Benefits and Risk." Annual North Carolina WIC Program Conference, September 2007, Raleigh, NC.

Martha Keating. "Southern Center on Environmentally Driven Disparities in Birth Outcomes." North Carolina Preconception Health Task Force, Women and Obesity Work Group, January 2008, Chapel Hill, NC.

Supplemental Keywords
Risk communication, outreach, translation, participatory research, built environment

Geographic Information System and Statistical Analysis Core

Period covered by the report: 5/1/2007 – 4/30/2008
EPA Agreement Number: RD83329301-0
Investigators: Alan Gelfand (PI), Allison Ashley-Koch, Jonathan Goodall, Marie Lynn Miranda, Jerome Reiter
Project Period: Year 1

Objectives of Research
The overall objective of the GIS and Statistical Analysis Core is to **support spatial and quantitative analysis needs of the Center research projects, as well as the Community Outreach and Translation Core.** Our specific aims include:

1. Providing support for the development of environmental and social data layers needed to implement data analyses required for the research projects and the Community Outreach and Translation Core;

2. Providing statistical analysis, advice, and consulting on the broad range of statistical issues that arise in conjunction with the research projects, with a particular emphasis on data reduction methods and modeling spatial and spatio-temporal data within a Bayesian framework; and,

3. Providing analysis for the unique needs of genetic data arising from the clinical and animal studies of the center.

This support core facilitates the development of innovative quantitative methodology for children's environmental health research associated with the projects and cores. Equally important, it will enhance substantive collaboration between statisticians and scientists involved in the research projects yielding improved analyses of research core data, as well as novel statistical modeling.

Progress Report/Summary of Accomplishments
In the first year of the project, the GISSA Core has focused on developing the data warehouse providing underlying support for all other Center components. We have acquired and georeferenced additional detailed birth record data, begun genotyping blood samples from the participants in Project B, and continued providing data management support as Project B continues to enroll additional participants.

We now have in hand identified North Carolina Detailed Birth Records (DBR) at the individual subject level, giving us access to 17 years of birth data covering 1990-2006. The DBR is compiled from questionnaires obtained at the time of birth certificate filing and includes elements essential to our proposed analyses. Available variables include, *inter alia*: maternal residence and state and country of birth; marital status; maternal and paternal race, Hispanic ethnicity, and education; alcohol and tobacco use; plurality; parity; maternal complications; congenital anomalies; whether an infant death certificate was filed; and infant birth weight and gestational age. All years of data have been integrated and standardized to facilitate data linkages and statistical analysis.

The GIS team has worked to street-geocode all residential addresses from all years of the DBR data for the State of North Carolina. Street geocoding efforts, which allows us to link births to Census data resolved at the block level, have been georeferenced for 75% of 1990-2003 birth records, with success rates increasing over time up to 82% by 1999. Preliminary street geocoding of the 2004-2006 DBR has georeferenced 69% of the birth data, with significant increase in the success rate expected as these efforts progress. Additionally, in Durham County, all years of birth data have been geocoded to the individual tax parcel, with an overall success rate of 94%.

To date, we have generated genotypes on 624 blood samples from pregnant women for 104 Single Nucleotide Polymorphisms (SNPs) in sixteen genes, primarily involved in either metabolism of heavy metals or the immune response. We anticipate beginning statistical analysis on these data in Year 2.

Collaborations with other SCEDDBO Components
By its nature, the GISSA Core is highly involved in collaborations across all Center components. We are working with the investigators of Project A to determine what spatial data layers need to be developed and at what spatial scales. We are also creating the data architecture to facilitate linkages of the data compiled by Projects B and C in order to create opportunities for synergies across projects.

Future Activities
We will continue developing and expanding the geospatial data warehouse that supports analysis among various projects. The GIS team will also work with investigators in Projects A and B to develop a comprehensive list of environmental spatial data layers of interest, as well as a plan for prioritizing the development of this crucial dataset.

For Buncombe, Durham, Forsyth, New Hanover, Pitt, and Wilson Counties, we plan to geocode all years of the detailed birth records at the tax parcel level. This effort has already been completed for Durham County. This will provide us with additional geospatial resolution, and will allow us to link the data to the tax assessor databases and, in Durham County, to the additional environmental and demographic overlays.

We will begin preliminary analyses on approximately 700 – 800 participants with complete pregnancy data, genetic results, and environmental results. Analyses will look at the joint impact of environmental, social, and host factors on birth outcomes, especially as they differ by race. Identification of such co-exposures could lead to development and implementation of strategies to prevent adverse birth outcomes, ultimately decreasing or eliminating the racial disparity.

Maternal blood samples will be analyzed for both protein and genetic associations with adverse birth outcomes. Maternal samples collected at 24 – 28 weeks gestation will be analyzed for protein levels involving markers of inflammation, vascular dysfunction, and stress response. DNA analysis is well underway with genotyping completed for several genetic polymorphisms regarding environmental contaminant metabolism as well as inflammatory cytokines and chemokines. Genotyping will include genes involved in the maternal stress response and vascular/endothelial cell dysfunction. Statistical analysis regarding candidate gene polymorphisms will begin in June 2008. We will continue to genotype SNPs in the candidate genes we had proposed, as well as genotyping new, pertinent genes as the literature suggests (ie GRK2/GRK5 as described by Liggett et al., 2008). In addition, during year 2, we will begin genotyping functional polymorphisms such as the 5HTTLPR in the serotonin transporter.

Publications
All manuscripts supported by the GISSA Core are listed under the individual research projects.

Supplemental Keywords
Data fusion, meta analysis, disparities, spatial disaggregation, spatial interpolation, spatial modeling